[Proc. Roy. Soc. Victoria, 58 (N.S.), Pts. I.–II., 1947.]

Art. VII.—*The Victorian Earth Tremor of 3rd November, 1944.*

By A. J. GASKIN, M.Sc.

[Read 12th July, 1945]

A strong earth tremor occurred in Victoria on November 3rd, 1944. In the Melbourne area, it was felt between five and six minutes after midnight of November 2nd. The tremor was generally described as beginning with an audible phase, which varied, according to the locality, from a loud crack to a low rumbling sound, followed or accompanied by one or more phases of more or less intense vibration lasting from one to four seconds.

The shock was recorded by the seismograph at Melbourne Observatory. The period of vibration was not great enough to be measurable on the record. The velocity of travel of the light beam in the photographic recorder being comparatively high, the peaks of the waves on the trace have been underexposed so that the maximum amplitude cannot be determined with certainty. It was probably not much more than 2 mm., corresponding to a ground movement of 8μ at the Observatory. The following measurements were obtained from the record:—

i	14 h. 05 m. 43 s.
i	14 h. 05 m. 46 s.
i	14 h. 05 m. 49 s.
i	14 h. 05 m. 53 s.
M	14 h. 05 m. 57 s.
m	14 h. 06 m. 03 s.
m	14 h. 06 m. 08 s.
F	14 h. 06 m. 30 s.

(Universal time.)

The distance of the epicentre from Melbourne as estimated from the P–M interval is of the order of 45 miles, which is nearly twice the distance of the Mornington epicentre from Melbourne (Holmes, 1933). This accounts in part for the smaller amplitude of the 1944 tremor as recorded in Melbourne. The over-all intensity of the 1944 tremor was, however, considerably less than that of the 1932 shock, minor destructive effects in the epicentral area of the 1944 shock being comparatively rare.

Following a public request for information, about 100 reports concerning the tremor were received from observers in the Melbourne area, and about 75 from country observers. Intensities on the modified Mercalli scale (Wood and Neumann, 1931) were assessed from these reports, and mapped in an attempt to determine the epicentre of the shock. Because of the small degree of variability of intensity shown between reports from widely separated areas, this procedure did not give a particularly accurate map of the isoseismals, but when the nature and duration of the phases of the tremor (described in most reports) were taken into account, a more satisfactory approximation to the epicentre was obtained (see text fig.). Reports from localities within the 4 isoseismals describe the audible phase as a loud crack, with a very short interval between it and the subsequent phase of movement. The latter was felt as a very rapid jolting vibration of from one to two seconds' duration. With increasing distance from the epicentral region, the preliminary audible phase was reported to become lower in pitch, dying away to a dull rumble in localities near the 3 isoseismal. In most districts outside the 3 isoseismal, the tremor produced a slower, more rhythmic, ground movement, unaccompanied by an audible phase.

Although the maximum reported intensity of the tremor was little more than 4, allowance must be made for the fact that the main epicentral region is situated in uninhabited mountainous country near the Cerberean

Isoseisms of the Victorian Earth Tremor of November 3rd, 1944.
(Outermost broken isoseism represents limit of detection of shock.)

Ranges, a district from which no information could be obtained. It is probable, however, that the maximum intensity of the tremor was nowhere greater than 4·5, and the shock appears to have been of a multiple focus type, due to shallow depth fault movements associated with a N.E.–S.W. stress line.

The suggestion of a multiple focus effect is based on the presence of the local epicentres near Healesville and Mt. Dandenong. Their positions on the map are based on the various aspects of the reports received from these districts. One aspect of the reports, that of the direction from which the audible phase appeared to come, although often found to be an unreliable factor in seismic work, gave reasonable evidence in this case, as the directions reported, with very few exceptions, pointed to the two local epicentral areas.

At a point close to the line joining these two epicentres, two distinct audible phases were reported, the second being almost simultaneous with the ground movement phase of the first.

The assumption that the fault movement occurred at a relatively shallow depth is based on the sharp high-pitched nature of the audible phase in localities near the epicentres. Further evidence suggesting that the shock was connected with more than one focus is provided by the fact that it was felt over a considerable area (nearly 10,000 sq. miles), with no very great variation in actual intensity, although the epicentral areas were sharply defined by the character and time spacing of the phases. Blake (1941) has indicated that this type of shock is characteristic of simultaneous shallow-depth faulting along several inter-related lines in a stress zone.

The isoseismal map of the tremor (p. 67) shows that the three epicentral areas occur along a N.E.–S.W. line, which when produced to the S.W. joins the line of the Beaumaris monocline, and further S.W. the line of the Curlewis fault. It seems probable, therefore, that this line represents the strike of a fault or the trend of a stress zone in which minor faults are at present developing. Such a fault line would represent the north-western limit of the north-east south-west set of faults which are prominently developed in South Gippsland.

It is apparent from the map (p. 67) that the isoseismals are not only elongated along the direction of the stress zone containing the epicentres, but are asymmetrically distributed in directions at right angles to this zone. The shock waves have been transmitted to a much greater extent to the north-west of the stress zone than to the south-east. This effect is well shown on the map by the outermost (broken) isoseismal, which represents the limit of detection of the tremor. To the south-east of the epicentral area, this limiting isoseismal is very close to the Heath Hill and Bass River fault lines, so that it is almost certain that the relatively incompetent Jurassic and Tertiary sediments to the south-east of these faults have absorbed the rather high frequency shock-waves characterizing the epicentral areas to a much greater extent than have the rigid igneous and sedimentary rocks of the basement complex to the west and north-west of the epicentral zone.

The other point of interest concerning the geologieal aspects of the tremor is the fact that the epicentral areas are all within or near the boundaries of thick Devonian dacite flows, which overlie a basement complex of intrusive igneous rocks and older folded sediments. This observation suggests that it was only at points where the stress zone intersected massive lava flows that fracturing occurred sufficiently suddenly to give rise to the high frequeney vibrations which characterize the districts that have been referred to above as epicentral areas.

There may be some significance in the faet that the tremor oecurred in a period of intense drought following a succession of dry seasons, during which it is probable that the level of the water-table had been reduced more in the mountainous dacite areas than in the low-lying country surrounding them. The resultant change in the total weight of the dacite mountain masses may have been sufficient to generate the trigger force, which caused the sudden release of pre-existing tectonic stresses.

References

Blake, A. (1941).—*Bull. Seism. Soc. Amer.*, Vol. 31, p. 230.

Holmes (1933).—*Proc. Roy. Soc. Vic.*, 45, n.s., Pt. II., p .150.

Wood and Neumann (1931).—*Bull. Seism. Soc. Amer.*, Vol. 21, p. 277.